AIA. In our test we used 12 experimental diets of similar nutritive value to determine apparent retention of nutrients and the AMEn by both techniques in 18 d-old broilers. The main difference among diets was the cereal used (corn *vs.* rice), the type of processing of the cereal (raw *vs.* heat processed), and the inclusion of a fiber source (none *vs.* 3% oat hulls *vs.* 3% soybean hulls) and all of them included 1% celite an additional indigestible marker. Each treatment was replicated three times (9 birds caged together). The AIA values of feeds and excreta were lower when determined by VK than when determined by VO (1.693 *vs.* 1.748% DM for diets and 6.655 *vs.* 6.961% DM for excreta; $P < 0.001$) but no interactions of technique x dietary treatment were found. The correlation coefficient of the AIA content of feeds and excreta between VO and VK techniques was good ($r > 0.99$). Nutrient digestibility and AMEn of the diets were lower when calculated with the VK technique than when calculated with the VO technique (74.6 *vs.* 75.0% for DM, 79.1 *vs.* 79.5% for OM, and 3,022 *vs.* 3,033 kcal/kg for AMEn; $P < 0.05$) but no interactions between techniques used for AIA determination and dietary treatments were observed. We concluded that either technique is acceptable to determine the apparent retention of nutrients and the AMEn of diets in poultry experiments.

Key Words: Acid–insoluble ash, Nutrient digestibility, Broilers

Nonruminant Nutrition: Enzyme Supplementation

W128 Investigating possible interactions between phytase and xylanase in wheat-based diets for growing pigs. T. A. Woyengo*[1], C. M. Nyachoti[1], J. S. Sands[2], and W. Guenter[1], [1]*University of Manitoba*, *Winnipeg, Manitoba, Canada*, [2]*Dansico Animal Nutrition*, *Marlborough, United Kingdom*.

An experiment was conducted to determine the effect of combining phytase and xylanase on total tract nutrient digestibility and performance of growing pigs. Ten wheat-based diets were fed to 60 (30 barrows and 30 gilts) Cotswold growing pigs from 19.9±1.2 to 60.2±2.4 kg BW. The ten diets included a control and a nutrient reduced (energy, Ca and P) diet supplemented with phytase at 3 levels, i.e, 0, 250 and 500 FTU/kg and xylanase at 3 levels, i.e, 0, 2000 and 4000 XU/kg in a 3x3 factorial arrangement to give 9 treatment combinations. Each diet was randomly assigned to 6 pigs balanced for sex. Chromic oxide was added to the diets (at rate of 0.5 %) during the first and last 10 d of the experiment to determine nutrient digestibility at about 20 and 60 kg BW, respectively. Enzyme supplementation had no effect ($P>0.05$) ADFI, ADG, G:F and crude protein digestibility. Phytase supplementation did not influence ($P>0.05$) energy digestibility while xylanase supplementation only increased ($P<0.05$) energy digestibility at 60 kg BW when it was given at 4000 XU/kg. Phytase supplementation increased Ca and P digestibilities ($P<0.05$) at both 20 and 60 kg BW. But there was no effect ($P>0.05$) of increasing the level of phytase on digestibility of Ca and P. Xylanase supplementation at 4000 XU/kg increased digestibility of Ca, but not of P, at both 20 and 60 kg BW. There were no significant interactions ($P>0.05$) between phytase and xylanase with regard to nutrient digestibility. In summary, phytase supplementation improved Ca and P digestibilities while xylanase improved Ca and energy digestibilities, but neither affected pig performance. Furthermore, there were no synergistic effects of phytase and xylanase on nutrient digestibility and pig performance.

Key Words: Wheat, Phytase, Xylanase

W129 Effects of supplemental dietary phytase and strontium on bone strength of weanling pigs fed a high phosphorus diet. P. K. Roy*, K. Yasuda, R. Maiorano, K. R. Roneker, and X. G. Lei, *Cornell University*, *Ithaca, NY*.

Our laboratory has previously shown positive impacts of supplemental microbial phytase (AppA2) and strontium (Sr) on bone traits of weanling pigs fed phosphorus-adequate diets. The aim of the present study was to determine if supplemental phytase (OptiPhos, JBS United, Inc., Sheridan, IN) and Sr (SrCO3, Alfa Aesar, Ward Hill, MA) still exerted that positive effect in pigs fed a high phosphorus diet. Forty pigs (BW = 7.60 ± 0.14 kg) were allocated into four groups (n = 10). Group 1 were fed a corn-soy basal diet (BD) + 0.25% inorganic phosphorus (iP, dicalcium phosphate) + 50 mg Sr/kg (Diet 1). Group 2 were fed Diet 1 + 0.10% iP (Diet 2). Group 3 were fed BD + 0.35% iP + 3,400 units of phytase/kg (Diet 3). Group 4 were fed Diet 3 + 50 mg Sr/kg (Diet 4). After 8-wk feeding, five female pigs close to the mean value from each group were killed to collect bone samples for mechanical analysis. Plasma iP concentrations and body weight of individual pigs were measured biweekly, and showed no differences between treatments. Elevating dietary iP from 0.25 to 0.35% in the diet containing 50 mg Sr/kg significantly ($P<0.05$)improved breaking strength of femur and metacarpals by 9 and 20%, respectively (Diets 1 vs. 2). Supplementing phytase in the diet containing 0.35% iP and 50 mg Sr/kg improved ($P < 0.05$) breaking strength of the two bones by 10 to 11% (Diets 2 vs. 4). Supplementing Sr in the diet containing 0.35% iP and phytase produced non-significant effect on bone strength (Diets 3 vs. 4). In conclusion, 3400 iu/Kg phytase supplementation improved bone strength of pigs fed diet containing 0.35% phosphorus, but the moderate level of Sr supplementation did not produce benefit as an alternative of phytase in those pigs.

Key Words: Pigs, Phytase, Strontium

W130 Supplemental dietary phytase and strontium improves bone traits of weanling pigs fed a phosphorus-adequate diet. A. R. Pagano[1], K. R. Roneker[1], K. Yasuda*[1], T. D. Crenshaw[2], and X. G. Lei[1], [1]*Cornell University*, *Ithaca, NY*, [2]*University of Wisconsin*, *Madison*.

Previous research in our laboratory has shown that dietary phytase supplementation at 2,000 units (U)/kg enhanced bone strength of weanling pigs fed phosphorus-adequate diets, possibly by improving dietary strontium (Sr) absorption. The objective of this study was to determine if supplementing Sr and phytase additively improved bone traits of those pigs. A total of 32 weanling pigs (BW: 11.4 ± 0.3 kg) were allotted to four groups (n = 8) fed a corn-soy, phosphorus-adequate (0.65%) basal diet (BD), the BD + Sr (50 mg/kg, $SrCO_3$, Alfa Aesar, Ward Hill, MA) , the BD + phytase (2,000 U/kg, OptiPhos, JBS United, Inc., Sheridan, IN), or the BD + Sr (50 mg/kg) + phytase (2,000 U/kg) for 6 wk. Weight gain, plasma alkaline phosphatase activity, and plasma inorganic P concentration of individual pigs were measured weekly, but no differences among treatments were detected. Femurs and metacarpals were collected from both front legs at the end of experiment to test mechanical properties, mineral density (BMD,

g/cm^2), and mineral content (BMC, g). Breaking load and BMD of metacarpal were improved (5 to 24%, P < 0.05) by supplemental Sr and(or) phytase. Femur BMD and metacarpal BMC were enhanced (P < 0.05) by supplemental phytase. Compared with the other three groups, pigs fed Sr + phytase had higher (P < 0.04) BMC (9 to 24%) and BMD (8 to 17%) of both bones and greater (P < 0.05) breaking load of femur (12 to 19%). No interactions of dietary Sr and phytase were observed on any of the measures. In conclusion, supplemental Sr and phytase additively improved bone development of weanling pigs fed phosphorus-adequate diets.

Key Words: Pigs, Phytase, Phosphorus

W131 The effect of adding high levels of phytase in the nursery/ grower diets on growth performance, carcass characteristics, and bone strength in grower-finishing pigs. T. C. Tsai*[1], C. R. Dove[1], M. J. Azain[1], and M. Bedford[2], [1]*University of Georgia*, *Athens*, [2]*Syngenta Animal Nutriton Inc.*, *RTP, NC*.

The objective of this study was to determine if there were sustained benefits of high levels of phytase (12,500 U/kg) in nursery /grower phase on subsequent performance. At an initial weight of 20 kg, 80 pigs were assigned to one of 5 dietary treatment groups in pens of 4 pigs (2 barrows, 2 gilts) each. There were three dietary phases fed: 20-45 kg, 45-90 kg and 90-130 kg during the 16 wk study. Diet 1 was the positive control and contained 0.35, 0.30 and 0.25% avail. P in the 3 phases, respectively. Diets 2-5 had no inorganic P added and contained 0.13, 0.10 and 0.10% avail. P. Diet 2 was the negative control diet. Diet 3 was supplemented with 500 U/kg phytase (Quantum 2500D™) in all phases; Diet 4 with 12,500 U in phase 1 and 500 U in phase 2 and 3; diet 5 had 12,500 U in phase 1 and 2 and 500 U/kg in phase 3. In phase 1, addition of 500 U/kg phytase (711g/d) increased growth over the negative control (650 g/d), while 12,500 U (863 g/d) normalized gain to that of the positive control (873 g/d). Overall, growth rate was greater in pigs that were fed high levels of phytase early and then lower levels than in those fed 500 U for the entire study. Phytase addition improved phosphorous digestibility in each phase. There was no effect of phytase on carcass characteristics when adjusted for BW. Metatarsal bone weight was reduced with the low P diet and increased with 500 U phytase. Bone weight was not different from the positive control in pigs that were fed 12,500 U phytase in phase 1 or 2. Percent ash and bone strength were reduced on the low P diet and restored with addition of any level of phytase. These results suggest that the benefits of feeding high levels of phytase in the nursery and or grower phase are sustained in the finisher phase.

Table 1

Diet: Phase:	1	2 Neg.	3 Control,	4 Phytase	5 (U/kg)		
20-45 kg	Pos.	0	500 U	12500U	12500U		
45-90 kg	Ctrl.	0	500 U	500 U	12500U	SEM	P
90-130kg		0	500 U	500 U	500 U		Value:
Gain, g/d							
20-45kg	873	650	711	859	868	20	0.001
20-130kg	989	721	896	952	1014	20	0.001
Slaughter wt., kg	130.6	101.5	122.2	127.0	133.9	2.7	0.001
Loin area, cm^2	47.9	38.5	43.4	48.8	47.1	1.1	0.001
Tenth rib fat, mm	20.9	16.6	21.3	21.4	22.6	1.2	0.01
Bone ash, %	45.4	37.2	44.0	45.4	45.9	1.0	0.001
Bone strength, kgf	117.4	54.9	106.0	91.1	110.0	8.4	0.001

Key Words: Pigs, Phosphorous, Phytase

W132 Effect of enzyme supplementation and inclusion level of wheat distillers dried grains with solubles on energy and nutrient digestibilities in growing pigs. F. O. Opapeju*, C. M. Nyachoti, and B. A. Slominski, *University of Manitoba*, *Winnipeg, MB, Canada*.

The influence of enzyme supplementation on energy and nutrient digestibilities in a barley-based diet containing 15% or 30% wheat distillers dried grains with solubles (DDGS) was evaluated. Four ileal cannulated growing barrows housed individually in metabolism crates were allotted to experimental diets in a 4×4 Latin square design with 2×2 factorial arrangement of treatments. The experimental diets were 1) 15% wheat DDGS without enzyme, 2) 15% wheat DDGS with enzyme, 3) 30% wheat DDGS without enzyme, and 4) 30% wheat DDGS with enzyme. Enzyme supplement consisted of xylanase, β-glucanase and cellulase as main activities. Chromic oxide (0.3%) was included in the diets as an indigestible marker. Following a 4-d acclimation period to experimental diets, ileal digesta were collected for 2 consecutive days for determination of apparent ileal digestibility (AID) of nutrients. Enzyme-supplemented diets had higher ($P < 0.05$) AID (%) of DM (67 vs. 65), organic matter (OM) (71 vs. 69) and energy (68 vs. 66) compared with diets not supplemented with enzyme. For indispensable AA, the effect ($P < 0.05$) of enzyme supplementation on AID (%) was only observed for methionine (82 vs. 77) and threonine (68 vs. 62). Level of DDGS inclusion had no effect on AID of DM, energy, OM, ash, phosphorus, calcium and indispensable AA except for arginine (82 vs. 78 % for 15 and 30% inclusion level of DDGS, respectively). There was an interaction effect ($P \leq 0.05$) of inclusion level of DDGS and enzyme supplementation on DM, ash and methionine. For example, enzyme supplementation improved ($P < 0.05$) AID of DM and methionine in the diet with 30% wheat DDGS whereas no such effect was observed in the diet with 15% wheat DDGS. In conclusion, the results indicate that wheat DDGS could be effectively utilized in growing pig diets and that higher amount of wheat DDGS could be used with appropriate enzyme supplementation.

Key Words: Enzyme supplementation, Pigs, Wheat distillers dried grains with solubles